



*Citation for published version:*

Nitsche, M & Richens, P 2005, 'Combining linear content and spatial design in Mindstage', Paper presented at Mit4: 4th Conference on Media in Transition, 1/05/05.

*Publication date:*  
2005

[Link to publication](#)

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## Combining linear content and spatial design for Mindstage

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### **Abstract**

Space has become a core element of modern new media artifacts but the step from textually described to visually and functionally represented spatial structure has still to be fully accepted. *Mindstage* is a proof of concept prototype that applies spatial design and corresponding interaction design to adapt a traditional linear lecture into an interactive 3D virtual environment. The project addresses issues of mapping the linear talk onto a predefined knowledge space and how to make this space freely explorable as a multi-user virtual world. The paper argues that such an approach provides the necessary flexibility and accessibility without losing the core lecture's content but also closes with a caveat on the limitations of such a design philosophy.

### **Keywords**

Spatial design, video game, virtual learning environment, film design, virtual architecture

## Challenging choices

Interactive real-time 3 dimensional virtual environments (RT 3D VE) operate like accessible stages that provide certain options to visiting users <sup>1</sup>. The action/ event/ fabula depends on these users who realize the it through ergodic participation <sup>2</sup>. The flexibility of such a fabula creation and the richness of a virtual world depend on its 'possibility space'. 'Possibility spaces' define the options a user has to operate within a certain situation in a virtual world. It is a feature mentioned by many leading video game designers <sup>3</sup>. In games, it is often manifested through the complexity of artificial intelligence driven behavior, character development, virtual objects, visualization, or spatial design – among other conditions. 'Possibility spaces' live from their openness and flexibility – how can any linear content ever fit into such a matrix? This tension outlines the problems for adaptations of linear pieces – may it be a given film story or a linear piece of music – in RT 3D VE.

Addressing this challenge, some design guidelines suggest to apply linear dramatic models to interactive formats through a path of pre-defined events <sup>4</sup> or via an adaptation of dramatic act structures from film and television into video games <sup>5</sup>. In contrast, hypertextual approaches operate with nodes and links forming branching networks – termed 'linkmeshes' by Crawford <sup>6</sup> – of varying sizes from a ever-extending branching tree to the rhizome of the Internet <sup>7</sup> where innumerable interconnections between different pages are made available by a shared protocol. The linking process and access replaces the fixed work. Finally, randomizing linking

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<sup>1</sup> (Murray 1997)

<sup>2</sup> (Aarseth 1997)

<sup>3</sup> Warren Spector in (Jenkins/ Squire 2002); also (Smith 2001); also (Wright 2005)

<sup>4</sup> (Wimberley/ Samsel 1995)

<sup>5</sup> (Siegel 1996)

<sup>6</sup> (Crawford 2000, 155)

<sup>7</sup> (Bolter 2001)

and access leads to Weinbren's proclaimed 'revolution of random access'<sup>8</sup>. Tracing any specific content becomes optional – the reading surpasses the story.

Research in artificial intelligence (AI) re-establishes such a structure through certain rules and behaviors. Agents – digital entities with an AI driven behavior – can participate in a dramatic event together with the user and can contribute to an underlying narrative setting or form<sup>9</sup>. A pioneering project for dramatic story-structuring through AI has been the Oz Project at CMU<sup>10</sup>. It influenced Mateas and Sengers to research the use of AI for dramatic characters<sup>11</sup> and had further impact on the work on agents at Stanford University<sup>12</sup>. In comparison, the MIT MediaLab's *Synthetic Characters Group* concentrated on a basic emotional behavioral model of agents<sup>13</sup>. Implementing such a complex behavior to RT 3D VE is difficult but has been delivered notably by Mateas and Stern's *Façade*<sup>14</sup> and the *Mimesis* system<sup>15</sup>. Although these AI systems have some form of spatial awareness they do not utilize the space of the virtual stage itself but focus on the actors that perform on it.

Space as a narrative structuring principle has been acknowledged in the debate on new media for some time<sup>16</sup>. A lot of the resulting work deals with social elements – often connected to the question of body and identity in virtual worlds<sup>17</sup>. But only recently visual represented space as opposed to textual described space has entered the academic debate in new media studies. Henry Jenkins originally

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<sup>8</sup> (Weinbren 1997)

<sup>9</sup> e.g. (Mateas 2002) also (Szilas 1999)

<sup>10</sup> (Bates 1994) (Bates/ Loyall/ Reilly/ Scott 1994) (Reilly 1996) (Loyall 1997)

<sup>11</sup> (Mateas/ Sengers 2002)

<sup>12</sup> e.g. (Hayes-Roth/ Van Gent 1996)

<sup>13</sup> from (Blumberg 1997) to (Tomlinson 2002)

<sup>14</sup> (Mateas/ Stern 2003) (Mateas 2002)

<sup>15</sup> (Riedl/ Young 2003)

<sup>16</sup> e.g. (Bolter 2001) (Ryan 2001)

<sup>17</sup> (Stone 1995) (Turkle 1996) (Schroeder 2002)

started from parallels between game explorations and travel logs <sup>18</sup> and developed his approach to the concept of games as 'spatial art' <sup>19</sup>. In comparison, Aarseth argues against a focus on the representational aspect and for an understanding of spatial representation in virtual worlds as symbolic and rule-based <sup>20</sup>. A parallel thought is carried further by Friedman who ultimately argues that 'its (= Civilization 2, a video game) primary narrative agent is geography' <sup>21</sup>. *Mindstage* – as a practical research project mainly interested in the spatial elements of RT 3D VEs – falls in-between the poles of representation and functionality.

### **The Mindstage approach**

The *Mindstage* project grew out of earlier work on the integration of narrative and mediated virtual architecture <sup>22</sup>. The basic research question was whether a RT 3D VE can be effective as a learning environment. What would be a sufficient architectural design of virtual space that could reinforce the piece's impact and promote engagement, exploration and memorability? The research focused on the design of an effective spatial arrangement of knowledge and design and implementation of the interactive exploration of such a structure. Virtual learning environments have become a wide-spread research area in new media; one that usually concentrates on networks and e-learning. 3D learning environments are a subset of this research. Within 3D learning environments one can trace a trend from early 3D experiments such as the *Active Worlds Educational Universe* <sup>23</sup> to the increasing use of video game technology exemplified in MIT's *Games to Teach*

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<sup>18</sup> (Fuller/ Jenkins 1995)

<sup>19</sup> (Jenkins/ Squire 2002) (Jenkins 2005)

<sup>20</sup> (Aarseth 2001)

<sup>21</sup> (Friedman 1999, n.n.)

<sup>22</sup> (Nitsche/ Roudavski/ Thomas/ Penz 2002) (Nitsche/ Roudavski/ Thomas/ Penz 2003)

<sup>23</sup> see <http://www.activeworlds.com/edu/index.asp>

project<sup>24</sup>. As games and their development platforms become more accessible to universities and individuals they get more easily adapted into educational programs. Many current games ship with special editors that support custom-generated content and encourage users to create own game versions. *Mindstage* is one example of the trend as it uses the game-prototyping development platform *Virtools*<sup>25</sup>. Technically, *Mindstage* was delivered as single standing proof of concept prototype running on consumer level personal computers. It needs 650Mb disk space, a 3GHz PC with 1Gb of RAM and a good 64Mb graphic card. Its multi-user functionality needs Internet access and targets seminar-sized groups of up to 7 students. Production limitations allowed us to include about 75 % of the overall material.

### *Design Philosophy*

*Mindstage*'s fundamental design approach reversed the idea of the 'memory palace' by mapping a pre-conceived academic lecture onto a navigable multi-user RT 3D VE. A virtual space was generated around the given lecture and the movement through the space referred to the argument of the talk. A pre-coded avatar represents the lecturer and guides students through the virtual world, moving from one object of interest to another while delivering the pre-recorded talk. Students can either decide to follow the lecturer-guide or explore the space by themselves or in groups.

To some degree the resulting overall design mirrors established narrative patterns and relates to linear dramatic models outlined above. After a linear video introduction, students have to select an avatar representation in a robing-room – a in-world event that might demarked a first action sequence. Consequently their entering into the main lecture space over a narrow bridge could be understood as transition

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<sup>24</sup> see <http://www.educationarcade.org/>

<sup>25</sup> for more details on the project's design and implementation process see (Richens/ Nitsche TBP)

from a ‘first act’ into the main content of the lecture space. Occasional path markings indicate the flow of the virtual lecture in the main space and support the guiding lecturer. Reversing the ‘deeper into the problem’ approach of many video games the overall movement direction in *Mindstage* is upwards leading up to the closing remarks presented at the highest point of the virtual architecture.

On the other hand, free exploration of the lecture space, interactive access and the multi-user features provide the necessary variety for a functional ‘possibility space’. In addition to the lecture, the virtual world includes interactive puzzles and illustrative material set in a shared multi-user world to support group-based learning and the student’s active involvement with the topic. To assemble these differing elements we had to combine linear story elements and non-linear exploration such as:

<b>Linear features in <i>Mindstage</i></b>	<b>Non-linear features in <i>Mindstage</i></b>
pre-recorded lecture audio	free multi-user text chat
predefined movement path of lecturer-avatar	free movement of student avatars
avatar selection	free-form exploration of illustrative material during own exploration
linear introduction and summary	logging in and out at any time

The underlying lecture of *Mindstage* is a talk of the highly acclaimed British film designer Christopher Hobbs whose credits include *Gothic*, *Long Day Closes*, *Caravaggio*, *Edward II*, the BBC *Gormenghast* trilogy, and *Mansfield Park*. The prototype aims at graduate students in the field of film and media studies – such as the M.Phil. in Architecture and the Moving Image at the University of Cambridge. These students often come from different backgrounds with different levels of

knowledge. In order to incorporate this diversity and optimize the educational impact, *Mindstage* allows for individual exploration of the content at any speed convenient to the individual student, exploration in a group during a multi-user session, and guided navigation through a lecturer avatar. The resulting overall design had to incorporate both elements: the highly non-linear free exploration with the unpredictable settings of a multi-user environment as well as the linear and pre-defined lecture. To address this challenge we concentrated on two main issues and their combination during the development of the *Mindstage* prototype:

- spatial design
- interaction design

Both of them had to support the linear guided tour as well as the non-linear exploration. In comparison to the other narrative models outlined above, our AI level was basic and only present in the lecturer avatar's behavior. We also did not focus on any kind of conditional hyper-linking – there are no secret paths to unlock, for example – but replaced it with a spatial arrangement of various single nodes.

### *Spatial Design*

*Mindstage*'s virtual world had to map the narrative structure of the lecture onto the virtual space to make it accessible in 3D. A number of architectural theories indirectly informed our design process. Hillier and Hanson's 'space syntax' <sup>26</sup> but especially Lynch's work on cognitive maps <sup>27</sup> stand out as relevant approaches. But our main reference point was Christopher Hobbs' lecture itself.

In a first step, we divided the lecture into chapters that related to central parts of Hobbs' talk: Perspective, Gothic and Texture. Where necessary we defined sub-

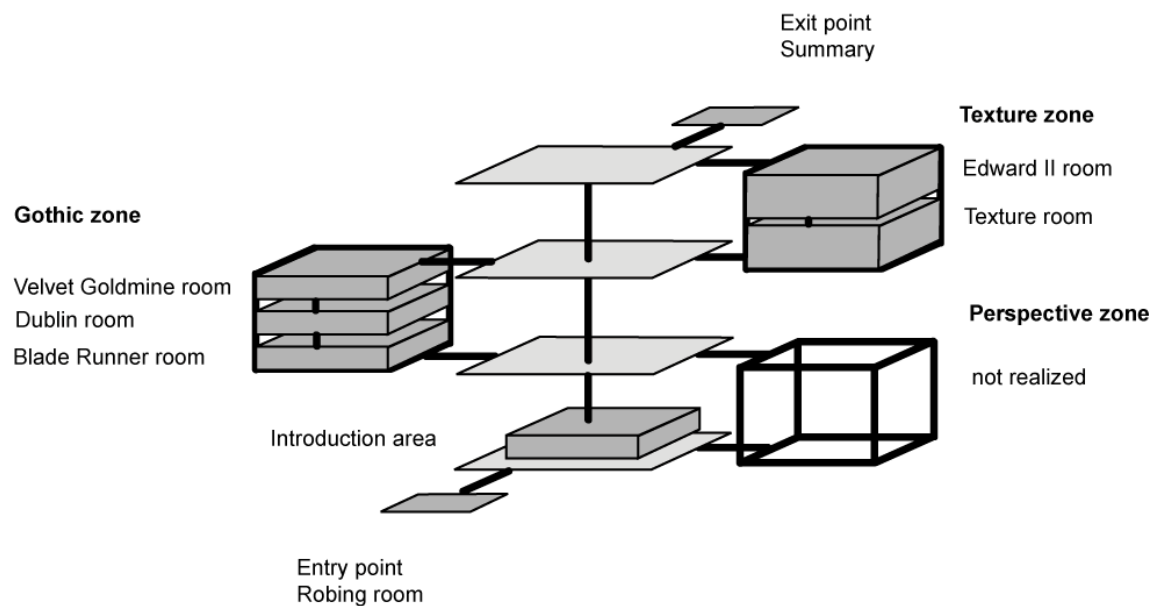
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<sup>26</sup> (Hillier/ Hanson 1984)

<sup>27</sup> (Lynch 1960)



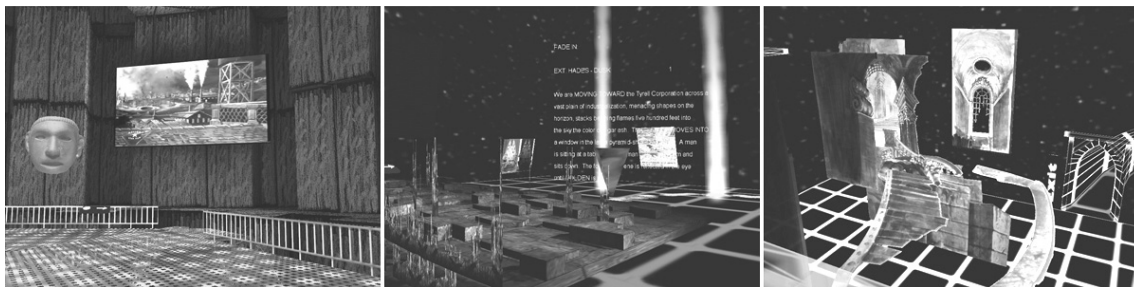
chapters within these main topics. This structure was translated into designated locations: *zones* signify chapters and *rooms* sub-topics of a chapter. *Rooms* and *zones* were assembled so that any student could follow the lecture seamlessly through space. The central theme, thus, provided the spatial design with a core path to which we added short-cuts and free navigable planes to allow for free access. As a result, locations can be explored in any order but are aligned along a principal path and the wider context of the *zones* following the argument of the lecture.



**Figure 1 – schema of the lecture break-down into *zones* and *rooms***

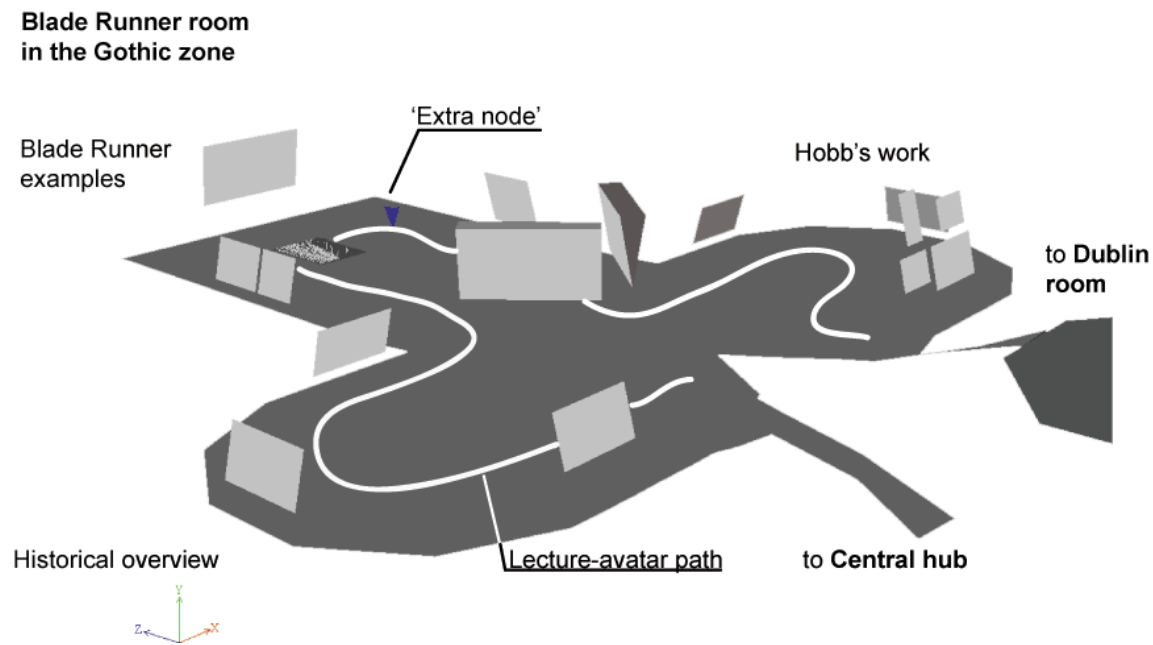
Each *room* contains a certain part of Christopher Hobbs' argument in the form of local nodes. Each node usually combines a statement from the lecturer-avatar and some illustrative material that supports the particular point. Most objects consists of film clips, stills, or 3D models. Other nodes were open puzzles that demanded students to interact with the material and explore the point of the lecture through playful interaction.

Like most lectures, Hobbs' talk included main points and chapters, digressions, footnotes, illustrations and examples, and glimpses ahead to upcoming parts of the lecture as well as references to established points. All of these rhetorical devices are suggestive of spatial equivalents and we tried to map them onto the virtual stage for the lecture. For example, the spatial design in most *rooms* allowed us to keep various elements visible at the same time. Thus it generated a visual reference between different items of the lecture. Students can see schematic 3D models referring to Scott's *Blade Runner* in combination to production stills, movie clips, screenplay excerpts, and storyboard sketches thanks to the depth of the spatial presentation and the avatar's position within the arrangement of the individual nodes.



**Figure 2 – introduction area: lecturer avatar presenting a film clip / *Blade Runner* room: spatial relationship between different objects / *Velvet Goldmine* room: interactive spatial puzzle**

Spatial arrangement replaced conditional linking. The *Blade Runner* room exemplifies the new freedom offered by this approach. The room has a pre-defined linear lecture path along which various nodes are aligned but as one enters the *room* the end of this lecture part is as visible and accessible as any other part of Hobbs' talk on *Blade Runner*. The first and the last page of the chapter are visible at the same time – open for exploration through spatial movement.



**Figure 3 – schema of the *Blade Runner* room within the *Gothic zone***

Virtual space literally becomes a basic narrative element and the basis for the flexibility of our ‘possibility spaces’.

### *Interaction design*

On the conceptual level, most of our problems in the interaction design centered on spatial and temporal issues of the multi-player feature and demanded a more fundamental re-interpretation of the linear lecture form. How could individual lecture elements stay available to different students at the same time and keep as many students engaged as possible? In order to provide different parts of the lecture simultaneously each *room* included a copy of the lecturer-avatar that operated independently from any other *room*’s lecturer. Such a multiplication of the lecturer avatar made different parts of the lecture accessible to different students at the same time. While one student might explore the *Texture zone*, another might visit the introductory part – both still sharing the same virtual overall space. Different parts of

the talk are accessible at the same time and different parts of the lecture-story can be told simultaneously. The division in spatially separate *rooms* prohibited any illogical collision of two lecture avatars and provided consistency to the situation.

The initial design included a voice-chat feature that would allow students to communicate via audio-link and discuss topics arising from the lecture. The feature was modified to a text-chat – in part because of technical difficulties but also due to design issues. In contrast to text-chat-rooms and drawing from online game environments we chose to display the chat as ‘speech bubbles’ above the student’s avatar. The chat becomes localized and supports through the interaction design our focus on spatial as structural element as students’ avatars have to be in the same *room* and face each other to chat effectively. Thus the interactive design forces a certain spatial behavior onto the students in contrast to the often confusing disembodied communication in multi-layered chats of text-only chat-rooms. In addition, text-chat sidesteps any acoustic rivalry between the lecturer, who delivers his talk as an audible presentation, and the students, who might have interrupted this audio stream with their own chatter. With the soundspace uncluttered, the spatialized audio from the lecturer avatar and other interactive objects operates as a guiding element that lures students into a close proximity to the lecturer avatar or other interactive objects <sup>28</sup>. It supports and motivates spatial exploration. Students follow the lecturer avatar not only to see how he interacts with the next node but also to stay within his audio range and hear the talk.

As additional regulative element we incorporated a hierarchical ‘override’ function for the lecturer avatar. Students can freely experiment with the content in the virtual world by starting and stopping film clips, starting 3D animations, and moving

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<sup>28</sup> for more examples for the value of acoustic landmarks in the sense of Lynch in virtual spaces see (Loomis et al 2002)

objects. But control over any object is taken over by the lecturer avatar whenever this special object is needed for his talk. Such an 'override' function guaranteed the consistency of the linear lecture without restricting the students' access to the objects too much. In addition, the lecturer avatar tracks the text-chatting during his talk and demanded attention if students would chat during his talk. He also tracks attendance of students at every single point of the lecture and will interrupt his talk if no student is in his proximity.

To further support our spatial design most of the student's interactions are dependent on the proximity to certain objects. For example, film clips can be started, stopped, and re-started by standing close to the relevant button, thereby selecting it, and then activating it. Visibility of some objects depends on collision with trigger objects and interactive spatial architectural elements such as elevators depend on avatar positioning,

Spatial restrictions and arrangements were our prime content assembly method, while the definition of the interactive access shaped how students could encounter this content. The combination of representational and functional space allowed us to use a different access method from the conditional linking available in web-based lecture forms. The spatial logic of the lecture space and the conditional logic that structured the access combined for a flexible prototype, where strict linear elements can be combined with free play. If we can find a distinction between 'hard rail' structures that tie a user to a basically pre-defined experience and 'soft rail' structures that are multidirectional and multi-linear, then spatial design and our basic interaction design allowed us to include a 'soft rail' approach to a 'hard rail' content.

## The value of space

The focus on spatial design and a multi-user interactive setting came with a price. It allowed us to experiment successfully with the spatial arrangements but excluded some features such as an internal assessment of student work. *Mindstage* offers its contents – it does not force it onto the student. That is why it lacks any directing ‘challenge’ that would drive the visitor to interact with the virtual world in a certain way<sup>29</sup>. *Mindstage* includes other essential learning elements such as the co-presence of a multi-user RT 3D VE that allows it to become a ‘social space’ - a key feature of virtual learning environments<sup>30</sup> as well as an essential element to create the quality of ‘place’ in virtual space<sup>31</sup>.

The story elements were weaved into the virtual space and as a result the virtual space gained significance. The story itself only comes to life through the user’s exploration of and interaction with the virtual space, mirroring the concept of Herman’s ‘Story Maps’<sup>32</sup>. This realization of the story through spatial navigation is the event concretization by the user within the given ‘possibility space’ offered by *Mindstage* and for which this paper has given some detailed design examples from the prototype.

One element that was merely touched by *Mindstage* and that deserves further examination is the design and implementation of user-created customized elements into a shared virtual space. *Mindstage* experiments peripherally with localized and unique visualizations of the main shared space. Students were able to activate *extra nodes* that materialized additional elements within the shared multi-user space but only visible to them. Combining this feature with an uploading of user-defined content

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<sup>29</sup> suggested e.g. in (Brophy 2003, 40)

<sup>30</sup> (Dillenbourg 2000)

<sup>31</sup> (Harrison/ Dourish 1996)

<sup>32</sup> (Herman 2002)

offers promising possibilities for the design and use of virtual story spaces. One that would still follow the spatial design options outlined in this paper but might exceed them towards a richer and more flexible version.

### **Acknowledgements**

*Mindstage* was conceived by Michael Nitsche, and implemented by the authors and Jonathan Mackenzie. Christopher Hobbs enthusiastically donated the content for the prototype. We were supported by the staff of the Cambridge University Moving Image Studio (CUMIS), especially Maureen Thomas. The project was funded from a generous grant from Informatix Inc of Tokyo.

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